ECOLOGICAL IMPACTS OF INVASIVE SPECIES on Native Species and Ecosystems

NOTE: Purple Text represents additions/corrections to what was said at the Forestry Workshop

I. Competition

II. Consumption (invasive species eat native species)

III. Other deadly impacts on individuals and populations

IV. Harm to Ecosystem Functions

(alterations in how plants, animals, and non-living components of ecosystems work together)

invasive shrub -- Winged Euonymus (“Burning Bush”)

What is this plant competing for?

- light
- space, above and below ground
- water and nutrients from soil

COMPETITION

Note how the fall color is muted in these plants that grew in the forest shade (as compared to the plants you see on roadsides). Many invasives also gain a competitive advantage by growing more each year because they leaf out earlier in Spring and continue to photosynthesize later in Fall. Certain wildflowers are able to grow in our shady forests only because they come up and flower before the trees leave out. Winged Euonymus, Japanese Barberry, and the hollow-stemmed, non-native Shrub Honeysuckles shade them out.

COMPETITION: What would happen to a rare plant?

COMPETITION via INTERFERENCE

Why is nothing growing around this Spotted Knapweed?

Spotted Knapweed grows well in dry areas. Notice that nothing is growing around it.

It puts out chemicals from its roots into the soil and these chemicals discourage the roots of other plants from growing in the area.

This is called *allelopathy.*

Allelopathy is a means of competing for the soil's water and nutrients by interfering with the ability of other individuals to grow nearby.

Spotted Knapweed is invasive in Connecticut on roadsides and dry pastures. It is a much bigger problem in arid western rangelands.

(Our native Walnut trees are another example of an allelopathic species.)

CONSUMPTION

Herbivory – plant consumption

Gypsy Moth larva eating a leaf – appears to be a Norway Maple leaf (note drop of white sap where vein is cut).
Gypsy Moths defoliate hardwood trees (esp. Oaks and Aspens). Once weakened, the tree may die from other causes (such as Shoestring fungus (*Armillaria* root disease) in Oaks).
Gypsy moth populations are now being checked by viral and fungal diseases.

Predation – animal consumption
(Note that some people consider herbivory a subclass of predation)

Feral house cats (and tame kitties that people let out of the house) kill native birds and small mammals – enough to reduce populations

REVIEW: Short Definition of Invasive = (1)___ and (2) ___.

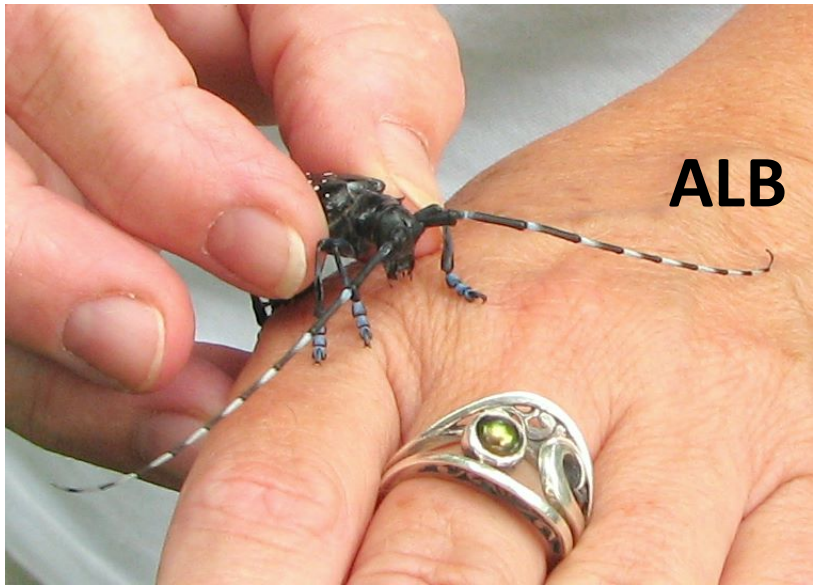
(1) = non-native (2) = causes harm

In Britain (and other parts of Europe), the non-native Eastern Gray Squirrel (from North America) outcompetes native Red Squirrel for acorns thereby reducing Red Squirrel populations.

The Gray Squirrel also is a source of Squirrel Pox – a disease found in North America that kills the European Red Squirrels that have no immunities to it. (Eastern Gray Squirrels are not killed by this disease – similar to the situation of European humans bringing the common cold to North America, a disease which killed Native Americans.)

DEADLY EFFECTS OF WOOD-BORING INSECTS

Asian Longhorned Beetle



EAB

Emerald Ash Borer
– is much smaller than ALB

Larval tunnels disrupt sap flow near the bark which kills the tree – but trees can undergo a lot of internal structural damage first.

The larvae of Asian Longhorned Beetle (ALB) and Emerald Ash Borer (EAB) eat inside tree branches and trunks in the active part of the wood close to the bark where sap and water are transported. They go into the heartwood (internal structural part not involved in water or sap transport) to pupate.

Large infestations disrupt the flow of water and sugars inside the tree which causes the trees to die.

ALB lays its eggs on many hardwoods, but Maples are its favorites. EAB is found only on Ash trees.

Think about differences in impacts to our forests.

OTHER EFFECTS - **HYBRIDIZATION**

invasive Eurasian Water-milfoil (*Myriophyllum spicatum* –EWM)
crosses with native Northern Water-milfoil (*M. sibiricum* – NWM)

TAKE NOTE:
Hybrid Eurasian Water-milfoil grows more vigorously than either parent

Also, Hybrid is resistant to 2,4-D which is a herbicide used to control EWM

If there is a lake with EWM, NWM and the hybrid, what might happen over time to the population of the native NWM?

{The native may be harmed because the hybrid will outcompete it.}

And what might happen to manager's ability to control unwanted water-milfoil with 2,4-D?

{The herbicide of choice, 2,4-D, will kill the native water-milfoil and the non-hybrid Eurasian water-milfoil, leaving the resistant hybrid. Even in the absence of herbicide, the hybrid may come to dominate a water body because it grows more vigorously (and so is a better competitor) at which point the 2,4-D will not work on the milfoil problem.}

HARM TO ECOSYSTEM FUNCTIONING

one species replaces many

WHAT HAPPENS THEN?

-Animals may lose the particular habitat they need for food or shelter.

-Diversity in **type** of food and **timing** of food availability is lost.

Japanese Knotweed

- much nectar, but narrow window of availability on site
- bamboo-like stalks are so tightly spaced, some wildlife cannot get through
- **when Japanese Knotweed gets into open, gravelly areas bordering streams where certain insects breed, the habitat is no longer suitable for the insect larvae. Then, fish that normally feed on those insects when they transform into adults and fly out over the water are deprived of a food source.**

Phragmites – aka Common Reed

The non-native subspecies of **Phragmites** (which in all but a few places has outcompeted the native subspecies in Connecticut and elsewhere in North America) fills waterbodies destroying open water habitat. Cover is too dense for ducks to hide in.

BIOLOGICAL DIVERSITY

Species Richness is one measure of biological diversity.
Richness = the number of different species present

Many bird species will nest in Phragmites, but the more rare species don't.

Imagine a site that gets invaded by Phragmites and one rare species is lost, and one new common species comes in.

Then, if we use species richness to measure bio-diversity, has bio-diversity at this site changed?

Answer: X number of original species – 1 rare species lost + 1 common species gained = X-1+1 = X
--- No change in bio-diversity {as measured by species richness} ***at this site***

What if there were 20 sites across the landscape that got invaded by Phragmites and at each one a different rare species was replaced by a common species (that was present at other sites in the landscape).

Then taking the landscape as a whole, would there be a change in species richness?

YES – species richness at the landscape level would be less.

Each of the 20 sites loses a species that was found only at that site, but the species it gains is already found somewhere else in the landscape. So the total landscape has lost 20 species and gained 0 new species resulting in a loss of diversity *at the landscape level*.

HARM TO ECOSYSTEM FUNCTIONING

Crazy Snake Worms [1]

Crazy Snake Worms (*Amynthas agrestis*) look like Night Crawlers (*Lumbricus terrestris*), but the light colored band around their body is not raised).

Crazy Snake Worms work in the leaf litter at the soil surface while Night Crawlers and other earthworms work deeper in the soil.

Example of Harm to Ecosystem Functioning:

- detrimental change in nutrient cycling in soils

- detrimental change in forest floor habitat

Worm castings deposited at the soil surface (rather than mostly in the soil) area a sign of Crazy Snake Worms.

These castings are rich in nutrients.

One pile of worm castings is soon followed by many.

In a back yard, the lawn may be damaged.

In the forest, the protective layer of decomposing leaves disappears.

HARM TO ECOSYSTEM FUNCTIONING – Crazy Snake Worms continued

As the worms bare the surface of the soil, the nutrients that are in their castings will be lost to the ecosystem when the castings erode and run off with rainwater.

Small organisms that normally live in grass or forest floor leaf litter lose their habitat so their populations decline or even become extirpated.

Garlic Mustard, an invasive plant is more easily established in soil that lacks leaf litter.

Some people have associated the presence of Garlic Mustard with the absence of Spotted Salamanders.

But it is more complicated than you might think!

Mature Spotted Salamanders feast on Crazy Snake Worms.

Small Spotted Salamanders that have only recently transformed from their aquatic larval form (in vernal pools) cannot find any prey of a size they can fit into their mouths so they die.

Spotted Salamanders are long-lived; so population censuses of mature adults do not immediately reveal a problem in areas infested by Crazy Snake Worms.

HARM TO ECOSYSTEM FUNCTION

Nutria – Groundhog sized -- looks like an orange-toothed cross between a beaver and a rat. (Unlike a muskrat, the tail is round.)

COMPETITION FOR FOOD

Invasive Nutria consume huge numbers of marsh plant roots

AQUATIC HABITAT DEGRADATION

Bank caves in – putting erosion sediments in water

MARSHLAND HABITAT LOSS AND DEGRADATAION

Nutria fragment the continuity of marsh vegetation by denuding vegetation and by creating swimming channels

HARM TO ECOSYSTEM FUNCTIONING

In a laboratory study, invasive Purple Loosestrife was found to set up *a harmful chain of reactions*

Purple Loosestrife is a perennial plant that dies back to the ground each year.

First, nutrient cycling in the water is altered.

In the lab, native decomposers were found to be not very good at decomposing the dead stalks of Purple Loosestrife.

In the lab, it was found that the nutrients in the Purple Loosestrife stalks were not returned to the water as quickly as with native vegetation. This led to a lack of nutrients such as Nitrogen and Phosphorus needed for growth by algae.

In waterbodies (not polluted by excess N & P) fewer nutrients is a problem.

Frog tadpoles go hungry.

Second, with fewer nutrients, algae did not grow as well in the water.

Young tadpoles depend on algae.

With less algae, fewer tadpoles survived.

New Note: The study was done with Wood Frogs, which outside a laboratory, typically breed in vernal pools (which generally are not invaded by Purple Loosestrife). However, the concept seems reasonable that with less algae, there is less food for tadpoles of other frog species that breed in the non-temporary ponds invaded by Purple Loosestrife.

HARM TO ECOSYSTEM FUNCTIONING – Purple Loosestrife *continued*

The laboratory study of the ecological effects of Purple Loosestrife on aquatic nutrients, algae, and tadpoles ended with the effect on tadpoles.

But, by carrying out the further ecosystem consequences in a logical manner, it seems reasonable to believe that…

(1) Fewer Adult Frogs

When fewer tadpoles survive, there are fewer new adult Frogs to replace those that get eaten each year by other animals.

(2) Predators of Frogs have less to eat.

Predators of Frogs include Owls, Raccoons, and other animals.

Ecological Impacts of invasive species can be

<u>complicated</u>

…

And you might not see
that a problem has been building up
until there is a change that you just can’t overlook.

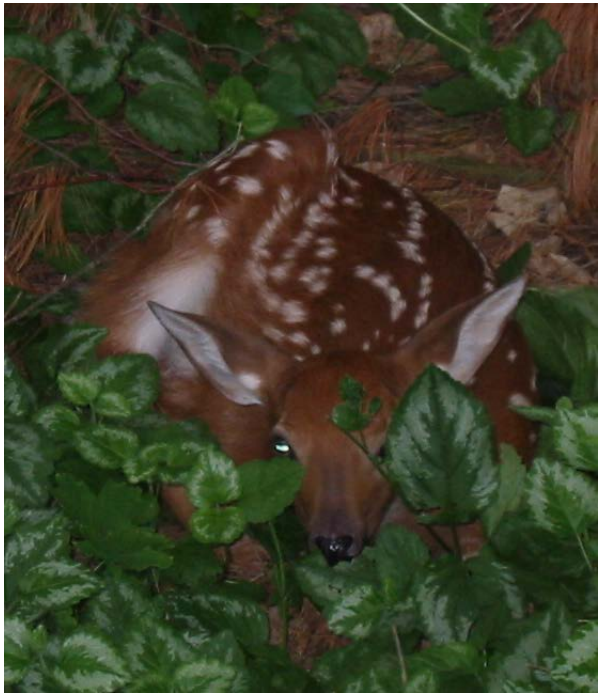
JAPANESE BARBERRY *Berberis thunbergii*

Complicated way Japanese Barberry causes both *ecosystem change* and *Harm to Human Health*

Japanese Barberry was introduced with good intentions
- for erosion control and
- as a wildlife food (particularly favored by Chinese Pheasants – an introduced game bird species).

Why is Barberry so successful in our forests?

Barberry so successful in our forests because...



- Like Winged Euonymus, Japanese Barberry is shade tolerant
- And, by leafing out early in the Spring and holding leaves late into the Fall,
  it gets extra growing time each year compared to native shrubs
- Japanese Barberry is not a part of the native food web.
  -- Its leaves provide no food for the native insect larvae that songbirds feed to their young
  -- Native deer (whose populations are out of control because formerly present large predators [e.g., wolves, cougars] have been extirpated in Connecticut) hungrily eat native shrubs
  -- And deer leave Barberry alone to spread into the spaces where the native shrubs once grew

The presence of Japanese Barberry in Connecticut is correlated with a higher incidence of Lyme Disease-carrying Deer Ticks

The Deer Tick (aka Black-legged Tick) is native

The Lyme Disease spirochete is native

The problem is the way the presence of Japanese Barberry has concentrated Lyme Disease-carrying Deer Ticks.

- young Deer Ticks (in their larval and nymphal stages) are likely to be feeding on White-footed Deer Mice
- White-footed Mice like to hide from predators in dense, prickly Japanese Barberry thickets
- after consuming a blood meal, Deer Ticks drop off the mouse and they have a higher rate of survival in the moister microclimate found beneath the Barberry (as compared to other places in the forest understory)

When Jeff Ward of The CT Agricultural Experiment Station and his colleagues walked through forest understories capturing insects with nets, they found more Deer Ticks in Japanese Barberry. And, there was a higher likelihood that the Deer Ticks found in Japanese Barberry were carrying Lyme Disease.

White-tailed Deer complicate the situation again because they move the adult Deer Ticks large distances -- much greater distances than Deer Mice carry the tiny, larval/nymphal Deer Ticks. AND, Japanese Barberry often is present in areas frequented by Deer.

~End of Ecological Impacts of Invasive Species~

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For more info on *Impacts of Invasive Species*, also look at the slide show for Economic Impacts.

In addition, there is a separate file of mid-year notes,
some of which were covered at the beginning of the Ecological Impacts presentation.